ditional notes have been received, giving the dates and locations of slight shocks:

June 3.—*Washington*, Lakeside, slight, time not given.

6th.—*Kentucky*, Richmond, 2:30 a. m.

8th.—*California*, Ukiah.

9th.—*California*, Upperlake, 12:45 p. m.; Ukiah.

11th.—*Vermont*, Vernon, 1:45 a. m.; jarred the house. *California*, Ukiah.

14th.—*Alabama*, Riverton, slight. *Arkansas*, Corning, 9:20 a. m.; Osceola, 9:28 a. m. *Kentucky*, Blandville, Owensboro, and Union City, at about 9:15 a. m. *Missouri*, New Madrid, 9:20 a. m., several seconds' duration; Gordonville, 9:25 a. m. *Tennessee*, Bolivar, Wildersville, and Savannah, 9:30 a. m.; Memphis, 9:25 a. m., lasting two minutes. *Indiana*, Evansville, 9:30 a. m.

23d.—*California*, Descanso, 1:44 p. m.

24th.—*California*, Descanso, 2:45 p. m.

26th.—*Kentucky*, Richmond, 2:30 a. m.

30th.—*California*, Los Angeles, 11:28 p. m., shock from southwest to northeast of about two seconds' duration. The shock seems to have been of a local character. Articles were thrown about, and a rumbling noise was heard. No reports of a quake from any neighboring city were received, notwithstanding numerous inquiries.

MATHEMATICS AND METEOROLOGY.

A student asks that a brief course of mathematics be laid out for him which will fit him to teach meteorology to ordinary college classes. He does not himself wish to go into extended research work in mathematical meteorology, but he wants to get enough mathematics to give him an understanding of meteorological text-books and articles. His present preparation is that ordinarily pursued for entrance into the freshman class, namely algebra, plane geometry, and plane trigonometry.

Assuming that the applicant wishes to teach the correct theory or explanation of meteorological apparatus, such as is given in the "Treatise on Meteorological Apparatus and Methods," published in the Report of the Chief Signal Officer for 1887, and that he also wishes to thoroughly understand, if not teach, the thermodynamics implied in such text-books as those of Ferrel, Davis, and Waldo, and which forms the vital part of dynamic meteorology, and that he, furthermore, wishes to fortify himself as to fundamental principles which should guide one in the study of statistical climatology, it is probable that his wisest course is to spend at least two years more in the study of pure mathematics, and, also, two years in practical work in the laboratory on experimental and theoretical physics. Assuming that his lectures and text-books must be in the English language, we can in the following lines refer only to a limited number of works in that language, but, if any way possible, the student should be careful to select as his teacher or adviser one who is familiar with what is published in other languages.

The first step must be to conquer solid geometry, spherical trigonometry, and analytical geometry, to which end one may take almost any one of the serial school text-books, such as those of Bowser, Chauvenet, Loomis, Newcomb, Todhunter, Wells, Wentworth, or Williamson.

Next to these analytical treatises graphics must claim his attention, viz, perspective, descriptive geometry, the projections of the sphere, as applications of these are continually occurring in meteorological work.

The mechanics of masses, whether solid, liquid, or gases, is, of course, fundamentally important, and before attacking the more difficult treatises it is advisable to study some elementary work, such as Smith's Elementary Mechanics, which was first prepared in 1849 for the students at Wesleyan but was subsequently taught to the students of the Naval Academy at Annapolis. In connection with this, read the Elementary Mechanics of Oliver J. Lodge and, also, Clerk Maxwell's little manual, Matter and Motion.

As some knowledge of the whole range of physics is essential, the student may take up for elementary home reading the admirable Everett's Translation of Deschanel, and will also profit as to more recent discoveries by reading Barker's Physics in that connection. The first part of Deschanel has to do with mechanics and should be read in connection with works previously mentioned. The chapter of Deschanel on heat should also be read in connection with the special treatises of Maxwell, Stewart, Tillman, or Tait in order that the student may get the elements of thermodynamics clearly before his mind.

The preceding will prepare one for nearly all that is necessary in order to understand my Treatise on Meteorological Apparatus and Methods, most of which, in fact, the student should have read as he progressed in the study of physics.

As a guide to reasoning upon statistical climatological data, some treatise on probability, such as Merriman's Least Squares, may now be read, after which the student will proceed with ease through the Short Memoirs, translated in the Smithsonian Report for 1877.

The student should now prepare himself to study and appreciate thermodynamics and hydrodynamics. He will, already, have learned something about these from the works on physics above mentioned, but he will not make satisfactory progress in reading recent works in which these are applied to meteorology without first mastering the elements of the Calculus, for which study there are several excellent treatises, such as those of Bowser, Byerly, Courtenay, Todhunter, Williamson, to which should be added some treatise on differential equations, such as that of Boole or Johnson, and some treatise on the potential function, such as that of B. O. Peirce. From these he may proceed to such works as Bartlett's Analytical Mechanics, Tait's Thermo-Dynamics, and Lamb's Hydrodynamics. Selected portions of the latter work may be chosen for their special bearing on atmospheric motion, and as preliminary to reading the translations of memoirs on the Mechanics of the Earth's Atmosphere, published by the Smithsonian Institution in 1893.

This seems a rather long journey before entering the realm of current literature in dynamic meteorology, but these are the royal gates through which one would prefer to pass in order that he may fully appreciate the present and future of our science. The path would be shortened if one or two special treatises were available for this purpose, or if one could read with another who had previously gone over the whole ground. In fact, much of this was condensed by Ferrel into one volume, viz, his Recent Advances, published in 1885, which is very convenient for reference, but is thought to be too difficult to commend to the young student.

METEOROLOGY BY CORRESPONDENCE.

The so-called system of university extension in which it is sought to bring to the very doors of the homes of distant students many of the privileges enjoyed by those who study in person within the halls of the great universities is generally considered as applicable, especially to the study of philosophy, languages, and history, but not with great success to the physical sciences, since any advanced course in the latter demands an extensive laboratory apparatus. Among the sciences, descriptive botany, mathematical astronomy, mechanics, and pure mathematics have been included in the university extension work, but meteorology among others has been omitted, as far as we are aware. Now our experience assures us that there really is a widespread popular desire to come to a

better understanding of the processes going on within the atmosphere, and it is evidently the duty of the Weather Bureau to foster and respond to such desires to the best of its ability. The study of meteorology is just beginning to be considered as a course proper for high schools and colleges, but the difficulty is everywhere felt that properly educated teachers are not available. Under these circumstances the best that can be done consists in entrusting the teaching of both elementary and advanced meteorology to those whose training in experimental and mathematical physics has fitted them to appreciate the minor points, and conquer the major difficulties of the subject. As to those who can not attend academies and colleges, including many of the regular and voluntary observers of the Weather Bureau, the best course for them will be to pursue systematically either a general course of home study or a special course adapted to their individual difficulties. To both the young instructor and the older observers it may be appropriate to state that the Chief of the Weather Bureau is in hearty sympathy with them in both their desires and their difficulties, and hopes that if in any way the Editor can, by correspondence, be useful to them, they will freely address themselves to him.

When the "Laboratory Manual of Elementary Meteorology," promised by Mr. R. DeC. Ward, has been published, we shall, undoubtedly, have a book that will largely replace the correspondence method of study.

METEOROLOGICAL TABLES AND CHARTS.

By A. J. HENRY, Chief of Division of Records and Meteorological Data.

Table I gives, for about 130 Weather Bureau stations making two observations daily and for about 20 others making only one observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and the departures from normals in the case of pressure, temperature, and precipitation, the total depth of snowfall, and the mean wet-bulb temperatures. The altitudes of the instruments above ground are also given.

Table II gives, for about 2,700 stations occupied by voluntary observers, the highest maximum and the lowest minimum temperatures, the mean temperature deduced from the average of all the daily maxima and minima, or other readings, as indicated by the numeral following the name of the station; the total monthly precipitation, and the total depth in inches of any snow that may have fallen. When the spaces in the snow column are left blank it indicates that no snow has fallen, but when it is possible that there may have been snow of which no record has been made, that fact is indicated by leaders, thus (. . . .).

Table III gives, for about 30 stations furnished by the Canadian Meteorological Service, Prof. R. F. Stupart, director, the means of pressure and temperature, total precipitation and depth of snowfall, and the respective departures from normal values, except in the case of snowfall.

Table IV gives, for 26 stations selected out of 113 that maintain continuous records, the mean hourly temperatures deduced from the Richard thermographs described and figured in the Report of the Chief of the Weather Bureau, 1891–92, p. 29.

Table V gives, for 26 stations selected out of 104 that maintain continuous records, the mean hourly pressures as automatically registered by Richard barographs, except for Washington, D. C., where Foreman's barograph is in use. Both instruments are described in the Report of the Chief of the Weather Bureau, 1891–92, pp. 26 and 30.

Table VI gives, for about 130 stations, the arithmetical means of the hourly movements of the wind ending with the respective hours, as registered automatically by the Robinson anemometer, in conjunction with an electrical recording mechanism, described and illustrated in the Report of the Chief of the Weather Bureau, 1891–92, p. 19.

Table VII gives, for all stations that make observations at 8 a. m. and 8 p. m., the four component directions and the resultant directions based on these two observations only and without considering the velocity of the wind. The total movement for the whole month, as read from the dial of the Robinson anemometer, is given for each station in Table I. By adding the four components for the stations comprised in any geographical division the average resultant direction for that division can be obtained.

Table VIII gives the total number of stations in each State from which meteorological reports of any kind have been received, and the number of such stations reporting thunderstorms (T) and auroras (A) on each day of the current month.

Table IX gives, for about 70 stations, the average hourly sunshine (in percentages) as derived from the automatic records made by two essentially different types of instruments, designated, respectively, the thermometric recorder and the photographic recorder. The kind of instrument used at each station is indicated in the table by the letter T or P in the column following the name of the station.

Table X gives a record of rains whose intensity at some period of the storm's continuance equaled or exceeded the following rates:

Duration, minutes..	5	10	15	20	25	30	35	40	45	50	60	80	100	120
Rates pr. hr. (ins.)..	3.00	1.80	1.40	1.20	1.08	1.00	0.94	0.90	0.86	0.84	0.75	0.60	0.54	0.50

In the northern part of the United States, especially in the colder months of the year, rains of the intensities shown in the above table seldom occur. In all cases where no storm of sufficient intensity to entitle it to a place in the full table has occurred, the greatest rainfall of any single storm has been given, also the greatest hourly fall during that storm.

Table XI gives the record of excessive precipitation at all stations from which reports are received.

NOTES EXPLANATORY OF THE CHARTS.

Chart I.—Tracks of centers of high pressure. The roman letters show number and order of centers of high areas. The figures within the circles show the days of the month; the letters *a* and *p* indicate, respectively, the 8 a. m. and 8 p. m., seventy-fifth meridian time, observations. The queries (?) on the tracks show that the centers could not be satisfactorily located. Within each circle is given the highest barometric reading reported near the center. A blank indicates that no reports were available. A wavy line indicates the axis of a ridge of high pressure.

Chart II.—Tracks of centers of low pressure. The roman letters show number and order of centers of low areas. The figures within the circles show the days of the month; the letters *a* and *p* indicate, respectively, the 8 a. m. and 8 p. m., seventy-fifth meridian time, observations. The queries (?) on the tracks show that the centers could not be satisfactorily located. Within each circle is given the lowest barometric reading reported near the center. A blank indicates that no reports were available. A wavy line indicates the axis of a trough or long oval area of low pressure.